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(54) [Title of the Invention] **Antimicrobial and Deodorizing Composition**

(57) [Abstract]

[Means] An antimicrobial and deodorizing composition comprising an antimicrobial and deodorizing component, pH regulator and solvent, characterized in that the antimicrobial and deodorizing component comprises basic zinc carbonate and/or zinc oxide and oxycarboxylic acid combined at a molar ratio of 1:0.7 to 1:5 and adjusted to a pH of 4 to 9.

[Effect] The antimicrobial and deodorizing composition of the invention is a highly safe composition that simultaneously provides both effective deodorization of odors in the household and antimicrobial action.

[Claims]

[Claim 1] An antimicrobial and deodorizing composition comprising an antimicrobial and deodorizing component, pH regulator and solvent, characterized in that the antimicrobial and deodorizing component comprises basic zinc carbonate and/or zinc oxide and oxycarboxylic acid combined at a molar ratio of 1:0.7 to 1:5 and adjusted to a pH of 4 to 9.

[Detailed Description of the Invention]

[0001]

[Field of Industrial Application]

The present invention relates to an antimicrobial and deodorizing composition and, more specifically, to an antimicrobial and deodorizing composition safe for humans, animals and livestock that simultaneously provides both effective deodorization of odors, including kitchen, refrigerator, garbage can, toilet, and bathroom odors, and antimicrobial action.

[0002]

[Prior Art and Problems that the Invention Is Intended to Solve]

A number of odors are found in the common household. These household odors occur in a variety of locations in the home, including the kitchen, refrigerator, garbage can, toilet, and bathroom. The immediate source of these odors is nitrogen-containing compounds such as ammonia and amine or sulfur-containing compounds such as hydrogen sulfide and methyl mercaptan. These malodorous substances result from the breakdown of nutrient sources, such as fatty acid compounds, proteins and carbohydrates, by bacteria or other microorganisms.

[0003]

Recently a deodorizing aqueous dispersion containing zinc oxide, weak alkaline substances and binder resin as effective ingredients (Japanese Examined Patent Application No. 5-10950) and a deodorizing aqueous dispersion containing zinc compounds and aliphatic polycarboxylic acid or its salts as effective ingredients have been proposed as highly effective deodorizing substances for eliminating these types of malodorous substances.

[0004]

However, these deodorizing aqueous dispersions have the following drawback. They can be effectively used to eliminate odors when the basic zinc carbonate or zinc oxide used as the zinc compound is undissolved if they are blended, kneaded, impregnated or coated with coatings, synthetic resins, synthetic fibers, paper and the like prior to use, but are not practical in a household situation in which convenience and ease of use is required in the elimination of odors in such places as the kitchen, refrigerator, garbage can, toilet and bathroom.

[0005]

Because zinc oxide is insoluble, preparation of the compositions proposed in Japanese Examined Patent Application No. 5-10950, using zinc oxide in combination with weak alkaline agents such as sodium malate and sodium citrate in an aqueous solution, resulted in visually unappealing non-uniform compositions in which the effective ingredients had precipitated. The precipitation of the effective ingredients resulted in insufficient deodorization when a spray bottle with trigger was used to spray the compositions in malodorous bathrooms and kitchens. Insoluble matter also became stuck in the nozzle of the trigger sprayer when the non-uniform zinc oxide-

containing compositions were sprayed, significantly decreasing outflow. In addition, an insoluble white powder remained after use unless the time-consuming and laborious process of a final thorough washing with water was implemented.

[0006]

Preparation of the compositions proposed in Japanese Examined Patent Application No. 5-10951, using zinc oxide or basic zinc carbonate in combination with aliphatic polycarboxylic acid salts, such as sodium fluoride, sodium maleate, sodium malate, and sodium citrate, in an aqueous solution, also resulted in visually unappealing non-uniform compositions in which the effective ingredients had precipitated due to the insolubility of zinc oxide and basic zinc carbonate. Spraying of the compositions through a trigger sprayer resulted in the same disadvantages reported above.

[0007]

Additional preparation of compositions consisting of zinc oxide or basic zinc carbonate in combination with aliphatic polycarboxylic acid salts, such as maleic acid and fumaric acid, in an aqueous solution, resulted in compositions in which the effective ingredient of zinc oxide or basic zinc carbonate dissolved at first, but later gelled and precipitated when the pH was adjusted to the vicinity of 7 to 7.5 with inorganic salts, such as sodium hydroxide, and organic salts, such as triethanolamine, resulting in a visually unappealing composition. Spraying of the composition through a trigger sprayer in malodorous bathrooms and kitchens resulted in the same problems reported above.

[0008]

The immediate source of household odors is nitrogen-containing compounds such as ammonia and amine or sulfur-containing compounds such as hydrogen sulfide and methyl mercaptan, which result from the breakdown of nutrient sources, such as fatty acid compounds, proteins and carbohydrates, by bacteria or other microorganisms. An antimicrobial and deodorizing agent utilizing copper gluconate that is highly effective at removing these specific malodorous substances and eliminating odor has also recently been proposed (Japanese Unexamined Patent Application No. 8-198709).

[0009]

However, these compositions containing copper gluconate performed poorly in antimicrobial testing conducted to simulate a variety of households containing different nutrients from various sources.

[0010]

In short, an antimicrobial and deodorizing composition that offers improved solubility of zinc oxide or basic zinc carbonate, improved stability of the effective ingredients in the composition for reliable, safe and easy removal of household odors has not yet been developed.

[0011]

An object of the present invention is thus to provide a safe antimicrobial and deodorizing composition that offers improved solubility of zinc oxide or basic zinc carbonate and improved stability of the effective ingredients in the composition for effective deodorization of household odors and antimicrobial action.

[0012]

[Means for Solving the Above-Mentioned Problems]

After thorough research into a highly safe antimicrobial and deodorizing composition that would offer improved solubility of zinc oxide or basic zinc carbonate and improved stability of the effective ingredients in the composition for effective deodorization of household odors and antimicrobial action, the inventors of the invention succeeded in solving the above-mentioned problems by producing the present invention consisting of a composition comprising an antimicrobial and deodorizing agent, pH regulator and solvent, in which the antimicrobial and deodorizing component comprises a basic zinc carbonate or zinc oxide zinc compound and oxycarboxylic acid combined at a molar ratio of 1:0.7 to 1:5 and adjusted to a pH of 4 to 9.

[0013]

The invention thus provides an antimicrobial and deodorizing composition comprising an antimicrobial and deodorizing agent, pH regulator and solvent, characterized in that the antimicrobial and deodorizing component comprises basic zinc carbonate and/or zinc oxide and oxycarboxylic acid combined at a molar ratio of 1:0.7 to 1:5 and adjusted to a pH of 4 to 9.

[0014]

The antimicrobial and deodorizing composition is highly effective at eliminating odors in such locations as refrigerators, toilets, bathrooms, kitchens, shoe cupboards, entryways, and pet areas. It also has antimicrobial action and is extremely safe.

[0015]

The invention will now be described in more detail. The composition of the invention containing a basic zinc carbonate or zinc oxide zinc compound, oxycarboxylic acid, and a pH regulator to adjust the pH to between 4 and 9 removes malodorous gases through chemical reaction with and physical absorption of the malodorous substances. The zinc ions also function to give the composition antimicrobial properties.

[0016]

Basic zinc carbonate or zinc oxide (ingredient (A)) is used in the invention. The basic zinc carbonate compound used in the invention is also known as zinc hydroxycarbonate and is expressed by the following Formula (I):

$2\ ZnCO_3 \cdot 3\ Zn(OH)_2 \cdot H_2O$

[0017]

The zinc oxide is expressed by the following Formula (II):

ZnO

[0018]

Basic zinc carbonate and zinc oxide are white powders that are insoluble in water and ethanol. They are additionally low-moisture, nontoxic, without intrinsic odor, and do not present any handling issues because they are nontoxic to the human body and skin. They are also known to be safe through their use as a base for cosmetic materials. [0019]

The basic zinc carbonate or zinc oxide is preferably included in the antimicrobial and deodorizing composition in a concentration of 0.005 to 15 percent, and more preferably 0.01 to 10 percent, by weight. Concentrations of less than 0.005 weight percent will result in insufficient deodorizing and antimicrobial effect. Concentrations of more than 15 weight percent, on the other hand, will result in insignificant deodorizing and antimicrobial effect and decreased stability in composition. They are also uneconomical. The basic zinc carbonate and zinc oxide may be used singly or in combination.

[0020]

Oxycarboxylic acid (ingredient (B)) is also used in the invention. After much research into organic carboxylic acids that would dissolve basic zinc carbonate and zinc oxide and enhance the stability of the composition, the inventors discovered that oxycarboxylic acid is an effective base for enhancing the solubility of basic zinc carbonate and zinc oxide and the stability of the effective ingredients in the composition.

[0021]

In other words, the oxycarboxylic acid functions as an effective base for promoting the solubility of basic zinc carbonate and zinc oxide and stabilizing the zinc ions in the composition.

[0022]

Any oxycarboxylic acid having a pKa dissociation constant of 7 or less in aqueous solution (25° C) may be used. When basic zinc carbonate is used, this means that any oxycarboxylic acid dissolved in water with basic zinc carbonate that dissolves the basic zinc carbonate and increases the stability of the effective ingredients in the composition may be used. One or two or more different oxycarboxylic acids may be used.

[0023]

Specific examples of the oxycarboxylic acids that may be used include glycolic acid, lactic acid, hydroxybutyric acid, glycerin acid, malic acid, tartaric acid, methyl malate, citric acid, isocitric acid, benzoic acid and salicylic acid. Most preferably used among these from a safety perspective are the designated food additives, lactic acid, malic acid, tartaric acid and citric acid.

[0024]

The object of the invention is best met when the basic zinc carbonate or zinc oxide zinc compound and oxycarboxylic acid are combined at a molar ratio of 1:0.7 to 1.5 and adjusted to a pH of 4 to 9, or more preferably 5 to 8. If the concentration of oxycarboxylic is below the range defined above (lower molar ratio than defined above) the basic zinc carbonate or zinc oxide will precipitate without dissolving, resulting in insufficient deodorant and antimicrobial effect. The use of concentrations of oxycarboxylic above the range defined above (higher molar ratio than defined above) will result in adequate dissolution of the zinc compound, but it is wasteful and uneconomical, because it requires that more pH regulator be used.

[0025]

The invention additionally uses a pH regulator (ingredient (C)) to adjust pH. Any organic or inorganic salt having a pKa dissociation constant of 12 or less in aqueous solution (25° C) may be used. When basic zinc carbonate and malic acid are used, this means that any pH regulator that is capable of producing a pH of 4 to 9 when

dissolved in water with zinc carbonate and malic acid may be used. One or two or more different organic or inorganic salts may be used.

[0026]

Specific examples of the organic and inorganic salts include sodium glycolate, sodium lactate, sodium hydroxybutyrate, sodium glycerinate, sodium malate, sodium methyl malate, sodium tartarate, sodium citrate, sodium isocitrate, sodium benzoate, sodium salicylate, monoethanolamine, diethanolamine, triethanolamine, sodium carbonate, sodium hydroxide and potassium hydroxide. Salt counter ions, including sodium, potassium and ammonium, may also be used.

[0027]

Most preferably used among these from the perspective of the practicality and safety required of a deodorizer are the designated food additives, sodium lactate, sodium malate, sodium citrate, sodium benzoate, sodium carbonate, sodium hydroxide and potassium hydroxide.

[0028]

The pH regulator of the antimicrobial and deodorizing composition of the invention may be included in any ratio to the specified molar ratio of the basic zinc carbonate or zinc oxide zinc compound and oxycarboxylic acid that will provide the composition with a pH of 4 to 9, but the most preferable range of pH is the weak acid/neutral range of 5 to 8. Adjusting the pH of the antimicrobial and deodorizing composition of the invention to the weak acid/neutral range of 5 to 8 with the pH regulator is preferable not only for more effective deodorization of acid and alkaline odors, but for safety purposes as well.

[0029]

Deodorization and antimicrobial testing of an antimicrobial and deodorizing composition including stable zinc ions obtained by adjusting the pH of a combination of the basic zinc carbonate or zinc oxide zinc compound and oxycarboxylic acid in the specified ratio, which was stable over several days, showed equivalent deodorization and antimicrobial action to immediately following manufacture (initial).

[0030]

The invention uses a solvent (ingredient (D)). The solvent functions to keep the basic zinc carbonate or zinc oxide zinc compound and oxycarboxylic acid stable in liquid form, keep the pH regulator in solution state and maintain the pH of the antimicrobial and deodorizing composition between 4 and 9.

[0031]

Any solvent that keeps the basic zinc carbonate or zinc oxide zinc compound, oxycarboxylic acid and pH regulator in solution state may be used.

[0032]

Specific examples of the solvent that may be used include water, alcohols, and glycol alkyl ethers. Examples of the alcohols include aliphatic alcohols. Examples of the aliphatic alcohols include methyl alcohol, ethyl alcohol, propyl alcohol, ethylene glycol, propylene glycol, and glycerin. Examples of the glycol alkyl ethers include alklyene glycol alkyl ether solvents. Examples of the alkylene glycol ether compounds include ethylene glycol monobutyl ether, ethylene glycol monoethyl ether, diethylene glycol monobutyl ether, diethylene glyocl monoethyl

ether, propylene glyocl monobutyl ether, dipropylene glycol monobutyl ether, ethylene glycol monophenyl ether, triethylene glyocl monophenyl ether, triethylene glycol monobutyl ether, tripropylene glycol monobutyl ether, tripropylene ethylene glycol dimethyl ether, and polyoxyethylene polyoxypropylene glycol monobutyl ether. These may be used singly or in combinations of two or more. Water may also be added to the alcohols and glycols.

[0033]

The solvent or solvents may be included in a concentration of from 70 to 99 weight percent, and more preferably from 90 to 99 weight percent, to 100 weight percent of the antimicrobial and deodorizing composition. Concentrations in excess of this range will result in decreased solubility of the basic zinc carbonate or zinc oxide zinc compound and decreased stability of the composition. They are also uneconomical. Concentrations below this range will result in insufficient deodorizing and antimicrobial effect.

[0034]

Other optional ingredients may be included in the antimicrobial and deodorizing composition of the invention as appropriate. These optional ingredients include surfactants, lower alkylbenzene sulfonates or their salts used to maintain liquidity at low or high temperatures, hydrotropes such as ethylene glycol, disinfectants, preservatives and antifungals, fragrances, dyes, antioxidants, thickeners, and UV absorbers. The antimicrobial and deodorizing composition of the invention may also be used together with other deodorizers and deodorants. There are no limitations on compounds used as optional ingredients, as long as they are used in conventional deodorizers.

[0035]

The antimicrobial and deodorizing composition of the invention may be provided in a variety of forms, including gel, impregnated sheet with multiple holes, spray (trigger or dispenser spray system) and aerosol mist. It may also be placed in a container with a wick where it is absorbed and diffused through the capillary phenomenon.

[0036]

Regardless of whether it is provided in gel, spray, dispenser or aerosol form or used as a mist, the antimicrobial and deodorizing composition is safe for and will not damage items with which it comes into contact, including furniture and clothing, skin, and utensils. The antimicrobial and deodorizing composition is thus an effective deodorizing agent that can be effectively used to eliminate a variety of odors, including unpleasant common household odors, such as odors from pet feces and urine, pet areas, raw garbage, kitchens, in-sink food traps and strainers, bathrooms and toilets, bathtub and shower drains and gratings, shoes, garbage cans, drain outlets, shoe cupboards, air conditioners, curtains, tatami mats, floors, carpets, lockers, and automobile interiors, as well as tobacco odors in vehicles, body odor, menstrual odor, foot odor, odors from diapers, towels, rags, and handkerchiefs, and nitrogen and sulfur oxide-based odors.

[0037]

[Examples]

The invention will now be described in more detail through examples and comparative examples, but the invention is not limited by these examples.

[0038]

To evaluate the performance of the antimicrobial and deodorizing composition of the invention, the solubility of the basic zinc carbonate or zinc oxide was determined, and the solution appearance and stability of the composition after adjustment of pH, the ability to eliminate ammonia and hydrogen sulfide odors and antimicrobial activity were assessed. The methods used for the testing are described below.

Assessment of solubility, solution appearance and stability of composition

The base was combined with the specified quantity of water (approximately 20° C) in a 1000 mL beaker, then stirred for 60 to 90 minutes with a magnetic stirrer and let stand. The solubility of the basic zinc carbonate or zinc oxide was visually assessed. If the composition was found to be in a uniform solution state, the liquid pH was adjusted with a pH regulator and the composition was assessed for solution appearance and stability.

Method of assessment of ability to eliminate ammonia odors

Test sections prepared from filter paper 70 mm in diameter soaked in 1.0 cc samples were placed in the center of a 20 cm wide × 20 cm long × 20 cm high (8 liter) airtight glass container. A specified quantity of ammonia was added and the ammonia gas concentration was determined with an ammonia detector tube immediately after addition and 90 minutes after addition.

Method of assessment of ability to eliminate hydrogen sulfide odors

Samples (test sections prepared from filter paper 70 mm in diameter soaked in 1.0 cc sample) were placed in the center of a 25 cm wide × 25 cm long × 20 cm high (12.5 liter) airtight glass container. A specified quantity of hydrogen sulfide was added and the hydrogen sulfide concentration was determined with a hydrogen sulfide detector tube immediately after addition and 90 minutes after addition.

Antimicrobial activity

The antimicrobial activity of the composition of the invention was assessed through the growth or lack of growth of bacteria.

[0039]

(Preparation of inoculum solution)

Organisms pre-incubated in agar medium were harvested with a platinum loop and suspended in sterile normal saline to a density of a number 3 McFarland standard (approximately 10^8 CFU/mL). One part suspension was diluted with 100 parts normal saline for use as the inoculum solution. *S. aurea* 209P and *E. coli* IFO3301 were used as the test organisms. Example compositions prepared to 1 weight percent concentration, to be described in detail below, were used as the samples under evaluation.

[0040]

Subsequently, 1 mL samples of the above-mentioned example compositions prepared to 0.1 weight percent concentration were diluted with 19 mL standard agar medium (1/20 times) and cultured in plate agar, which was inoculated with one platinum loopful of inoculum solution and incubated for 48 hours at 35° C. After incubation, the plates were visually assessed for growth of bacteria.

[0041]

Comparative examples were prepared in the same concentration as the examples (0.1 weight percent) from copper gluconate, sodium lactate, sodium tartarate, sodium malate and sodium citrate and assessed for antimicrobial activity in the same manner as the examples.

[0042]

(Examples 1 and 2 and Comparative Examples 1 through 24)

The bases and specified quantity of water (approximately 20° C) were combined in 1000 mL beakers in the proportions indicated in Tables 1 through 4, stirred with a magnetic stirrer for 60 to 90 minutes and let stand. The solubility of the basic zinc carbonate or zinc oxide zinc compound and oxycarboxylic acid was then visually assessed. If the composition was found to be in a uniform solution state, the liquid pH was adjusted with a pH regulator. After the pH was adjusted, the composition was assessed for solution appearance and stability. Prepared samples were also assessed for stability after one month in 5° C and 15° C constant-temperature baths. The results are provided in Tables 1 through 4.

[0043]

[Table 1]

Solubility of basic zinc carbonate and appearance and stability of composition

	Example	Comparative Example						
	1	1	2	3	4	5	6	7
Zinc compound	*Zinc carbonate 5.0 g	Zinc carbonate 5.0 g	Zinc carbonate 5.0 g	Zinc carbonate 5.0 g	Zinc carbonate 5.0 g	Zinc carbonate 5.0 g	Zinc carbonate 5.0 g	Zinc carbonate 5.0 g
Oxycarboxylic acid	Citric acid mono-hydrate salt 15.0 g							
Carboxylic acid		Succinic acid 15.0 g	Maleic acid 15.0 g	Fumaric acid 15.0 g	Succinic acid 15.1 g	Maleic acid 15.1 g	Fumaric acid 15.0 g	
Carboxylate and oxycarboxylate					Disodium succinate hexa-hydrate 15.0 g	Disodium malate hydrate 15.0 g	Disodium fumarate 15.0 g	Trisodium citrate mono-hydrate salt 15.0 g
Acidic agent								
pH regulator	Monoeth-anolamine 9.66 g	Monoeth-anolamine 10.7 g		Monoeth-anolamine 10.5 g	Monoeth-anolamine 11.6 g	Monoeth-anolamine 12.3 g	Monoeth-anolamine 14.2 g	
Water	Balance	Balance	Balance	Balance	Balance	Balance	Balance	Balance
Total	500 g	500 g	500 g	500 g	500 g	500 g	500 g	500 g
** Basic zinc carbonate solubility	Dissolved ○	Dissolved ○	Un-dissolved ×	Dissolved ○	Dissolved ○	Dissolved ○	Dissolved ○	Un-dissolved ×
Liquid pH	7.0	6.7	–	6.7	7.1	7.2	7.1	–
Solution appearance of	Clear liquid	Cloudy with	–	Cloudy with	Cloudy with	Cloudy with	Cloudy with	–

composition after pH adjustment		composition	precipitate		precipitate	precipitate	precipitate	precipitate	
**Stability of composition		○	×	–	×	×	×	×	–
**Stability with storage	5° C (1 M)	○	–	–	–	–	–	–	–
	15° C (1 M)	○	–	–	–	–	–	–	–

*: Zinc carbonate is a basic zinc carbonate with the following chemical formula:

2 ZnCO3·3 Zn(OH)2·H2O

**: Assessment of basic zinc carbonate solubility and stability of composition

○: Clear liquid

×: Cloudy liquid, or contains impurities, sediment and/or precipitate

[0044]

[Table 2]

Solubility of basic zinc carbonate and appearance and stability of composition

	Comparative Example				
	8	9	10	11	12
Zinc compound	*Zinc carbonate 5.0 g	Zinc carbonate 5.0 g	Zinc carbonate 5.0 g	Zinc carbonate 5.0 g	Zinc carbonate 5.0 g
Oxycarboxylic acid					
Carboxylic acid					
Carboxylate and oxycarboxylate	Disodium succinate hexa-hydrate 15.0 g	Disodium malate hydrate 15.0 g	Disodium fumarate 15.0 g		
Acidic agent				HCL 15.1 g	Sulfuric acid 15.3 g
pH regulator				Monoeth-anolamine 8.60 g	Monoeth-anolamine 16.9 g
Water	Balance	Balance	Balance	Balance	Balance
Total	500 g	500 g	500 g	500 g	500 g
** Basic zinc carbonate solubility	Un-dissolved ×	Un-dissolved ×	Un-dissolved ×	Dissolved ○	Dissolved ○
Liquid pH	–	–	–	6.7	7.0
Solution appearance of composition after pH adjustment	–	–	–	Cloudy with precipitate	Cloudy with precipitate
**Stability of composition	–	–	–	×	×
Stability with storage 5° C (1 M)	–	–	–	–	–
Stability with storage 15° C (1 M)	–	–	–	–	–

*: Zinc carbonate is a basic zinc carbonate with the following chemical formula:

2 $ZnCO_3$·3 $Zn(OH)_2$·H_2O.

**: Assessment of basic zinc carbonate solubility and stability of composition

○: Clear liquid

×: Cloudy liquid, or contains impurities, sediment and/or precipitate

[0045]

[Table 3]

Solubility of zinc oxide and appearance and stability of composition

	Example	Comparative Example						
	2	13	14	15	16	17	18	19
Zinc compound	* Zinc oxide 5.0 g	Zinc oxide 5.0 g	Zinc oxide 5.0 g	Zinc oxide 5.0 g	Zinc oxide 5.0 g	Zinc oxide 5.0 g	Zinc oxide 5.0 g	Zinc oxide 5.0 g
Oxycarboxylic acid	Citric acid mono-hydrate salt 15.0 g							
Carboxylic acid		Succinic acid 15.0 g	Maleic acid 15.0 g	Fumaric acid 15.0 g	Succinic acid 15.1 g	Maleic acid 15.1 g	Fumaric acid 15.0 g	
Carboxylate and oxycarboxylate					Disodium succinate hexa-hydrate 15.1 g	Disodium malate hydrate 15.0 g	Disodium fumarate 15.0 g	Trisodium citrate mono-hydrate 15.0 g
Acidic agent								
pH regulator	Monoeth-anolamine 8.47 g	Monoeth-anolamine 9.56 g			Monoeth-anolamine 9.15 g	Monoeth-anolamine 9.65 g	Monoeth-anolamine 14.9 g	
Water	Balance	Balance	Balance	Balance	Balance	Balance	Balance	Balance
Total	500 g	500 g	500 g	500 g	500 g	500 g	500 g	500 g
** Zinc oxide solubility	Dissolved ○	Dissolved ○	Un-dissolved ×	Un-dissolved ×	Dissolved ○	Dissolved ○	Dissolved ○	Un-dissolved ×
Liquid pH	7.0	6.7	–	–	6.9	7.1	7.2	–
Solution appearance of composition after pH adjustment	Clear liquid com-position	Cloudy with precipitate	–	–	Cloudy with precipitate	Cloudy with precipitate	Cloudy with precipitate	–
**Stability of composition	○	×	–	–	×	×	×	–
Stability with storage: 5° C (1 M)	○	–	–	–	–	–	–	–
Stability with storage: 15° C (1 M)	○	–	–	–	–	–	–	–

*: The chemical formula for zinc oxide is: ZnO

**: Assessment of zinc oxide solubility and stability of composition

o: Clear liquid

×: Cloudy liquid, or contains impurities, sediment and/or precipitate

[0046]

[Table 4]

Solubility of zinc oxide and appearance and stability of composition

	Comparative Example				
	20	21	22	23	24
Zinc compound	* Zinc oxide 5.0 g	Zinc oxide 5.0 g	Zinc oxide 5.0 g	Zinc oxide 5.0 g	Zinc oxide 5.0 g
Oxycarboxylic acid					
Carboxylic acid					
Carboxylate and oxycarboxylate	Disodium succinate hexa-hydrate 15.0 g	Disodium maleate hydrate 15.0 g	Disodium fumarate acid 15.0 g		
Acidic agent				HCL 15.1 g	Sulfuric acid 15.3 g
pH regulator				Monoeth-anolamine 7.44 g	Monoeth-anolamine 16.9 g
Water	Balance	Balance	Balance	Balance	Balance
Total	500 g	500 g	500 g	500 g	500 g
** Zinc oxide solubility	Un-dissolved ×	Un-dissolved ×	Un-dissolved ×	Dissolved o	Dissolved o
Liquid pH	–	–	–	6.9	7.0
Solution appearance of composition after pH adjustment	–	–	–	Cloudy with precipitate	Cloudy with precipitate
**Stability of composition	–	–	–	×	×
Stability with storage 5° C (1 M)	–	–	–	–	–
Stability with storage 15° C (1 M)	–	–	–	–	–

*: The chemical formula for zinc oxide is: ZnO

**: Assessment of zinc oxide solubility and stability of composition

o: Clear liquid

×: Cloudy liquid, or contains impurities, sediment and/or precipitate

[0047]

(Examples 3 through 12 and Comparative Examples 25 and 26)

The bases and specified quantity of water (approximately 20° C) were combined in 1000 mL beakers in the proportions indicated in Tables 5 and 6, stirred with a magnetic stirrer for 60 to 90 minutes and let stand. The solubility of the basic zinc carbonate or zinc oxide zinc compound and oxycarboxylic acid was then visually assessed. If the composition was found to be in a uniform solution state, the liquid pH was adjusted with a pH regulator. After the pH was adjusted, the composition was assessed for solution appearance and stability. Prepared samples were also assessed for stability after one month in 5° C and 15° C constant-temperature baths. The results are provided in Tables 5 and 6. Note that the results for Examples 1 and 2 above are also included in Tables 5 and 6.

[0048]

[Table 5]

Solubility and appearance and stability of composition by molar ratio of basic zinc carbonate to carboxylic acid

	Comparative Example	Example					
	25	3	1	4	5	6	7
Zinc compound	*Zinc carbonate 5.0 g (0.08 mol)	Zinc carbonate 5.0 g (0.08 mol)	Zinc carbonate 5.0 g (0.08 mol)	Zinc carbonate 5.0 g (0.08 mol)	Zinc carbonate 5.0 g (0.08 mol)	Zinc carbonate 5.0 g (0.08 mol)	Zinc carbonate 5.0 g (0.08 mol)
** Oxycarboxylic acid	Citric acid mono-hydrate salt 4.21 g (0.040 mol)	Citric acid mono-hydrate salt 8.44 g (0.080 mol)	Citric acid mono-hydrate salt 15.0 g (0.143 mol)	Citric acid mono-hydrate salt 25.0 g (0.238 mol)	Citric acid mono-hydrate salt 35.0 g (0.333 mol)	dl-malate 15.0 g (0.143 mol)	dl-malate 25.0 g (0.373 mol)
pH regulator	–	Monoeth-anolamine 4.19 g	Monoeth-anolamine 9.66 g	Monoeth-anolamine 17.7 g	Monoeth-anolamine 26.1 g	Monoeth-anolamine 6.74 g	Monoeth-anolamine 16.34 g
Water	Balance	Balance	Balance	Balance	Balance	Balance	Balance
Total	500 g	500 g	500 g	500 g	500 g	500 g	500 g
Molar ratio of basic zinc carbonate to carboxylic acid	1:0.5	1:1	1:1.8	1:3	1:4.2	1:1.8	1:4.7
*** Basic zinc carbonate solubility	Un-dissolved ×	Dissolved ○	Dissolved ○	Dissolved ○	Dissolved ○	Dissolved ○	Dissolved ○
Liquid pH	–	7.0	7.0	7.0	7.1	6.9	7.1
Solution appearance of composition after pH adjustment	–	Clear liquid com-position	Clear liquid com-position	Clear liquid com-position	Clear liquid com-position	Clear liquid com-position	Clear liquid com-position

***Stability of composition		–	○	○	○	○	○	○
*** Stabilit y with storage	5° C (1 M)	–	○	○	○	○	○	○
	15° C (1 M)	–	○	○	○	○	○	○

*: Zinc carbonate is a basic zinc carbonate with the following chemical formula:

$2\ ZnCO_3 \cdot 3\ Zn(OH)_2 \cdot H_2O$

Molar values were calculated on the basis of a molecular weight of 125 for zinc carbonate.

**: Molecular weight of citric acid monohydrate is 210; molecular weight of dl-malate is 134.

***: Assessment of basic zinc carbonate solubility and stability of composition

○: Clear liquid

×: Cloudy liquid, or contains impurities, sediment and/or precipitate

[0049]

[Table 6]

Solubility and appearance and stability of composition by molar ratio of zinc oxide to carboxylic acid

	Com-parative Example	Example					
	26	8	2	9	10	11	12
Zinc compound	*Zinc oxide 5.0 g (0.123 mol)	Zinc oxide 5.0 g (0.123 mol)	Zinc oxide 5.0 g (0.123 mol)	Zinc oxide 5.0 g (0.123 mol)	Zinc oxide 5.0 g (0.123 mol)	Zinc oxide 5.0 g (0.123 mol)	Zinc oxide 5.0 g (0.123 mol)
** Oxycarboxylic acid	Citric acid mono-hydrate salt 6.53 g (0.062 mol)	Citric acid mono-hydrate salt 13.12 g (0.125 mol)	Citric acid mono-hydrate salt 15.03 g (0.143 mol)	Citric acid mono-hydrate salt 25.13 g (0.239 mol)	Citric acid mono-hydrate salt 35.08 g (0.334 mol)	dl-malate 15.02 g (0.224 mol)	dl-malate 25.06 g (0.374 mol)
pH regulator	–	Monoeth - anolamin e 7.08 g	Monoeth - anolamin e 8.47 g	Monoeth - anolamin e 16.71 g	Monoeth - anolamin e 24.78 g	Monoeth - anolamin e 6.74 g	Monoeth - anolamin e 16.34 g
Water	Balance	Balance	Balance	Balance	Balance	Balance	Balance
Total	500 g	500 g	500 g	500 g	500 g	500 g	500 g
Molar ratio of zinc oxide to carboxylic acid	1:0.5	1:1	1:1.2	1:1.9	1:2.7	1:1.8	1:3
*** Zinc oxide solubility	Un-dissolved ×	Dissolve d ○	Dissolve d ○	Dissolve d ○	Dissolve d ○	Dissolve d ○	Dissolve d ○
Liquid pH	–	7.1	7.0	7.1	7.1	7.0	7.2
Solution appearance of	–	Clear liquid	Clear liquid	Clear liquid	Clear liquid	Clear liquid	Clear liquid

composition after pH adjustment			com-position	com-position	com-position	com-position	com-position	com-position
***Stability of composition		–	○	○	○	○	○	○
*** Stabilit y with storage	5° C (1 M)	–	○	○	○	○	○	○
	15° C (1 M)	–	○	○	○	○	○	○

*: The chemical formula for zinc oxide is: ZnO

Molar values were calculated on the basis of a molecular weight of 81 for zinc oxide.

**: Molecular weight of citric acid monohydrate is 210; molecular weight of dl-malate is 134.

***: Assessment of basic zinc carbonate solubility and stability of composition

○: Clear liquid

×: Cloudy liquid, or contains impurities, sediment and/or precipitate

[0050]

(Examples 13 through 18 and Comparative Examples 27 through 30)

The bases and specified quantity of water (approximately 20° C) were combined in 1000 mL beakers in the proportions indicated in Tables 7 and 8 and stirred with a magnetic stirrer for 60 to 90 minutes. The basic zinc carbonate or zinc oxide zinc compound and carboxylic acid were dissolved in water and the pH of the composition was adjusted to the specified pH with a pH regulator to produce the samples for assessment of elimination of odors (ammonia and hydrogen sulfide). The samples were used to assess the elimination of odors.

[0051]

[Table 7]

Liquid pH and odor elimination effectivity of basic zinc carbonate, oxycarboxylic acid and pH regulator compositions

	Com-parative Example	Example			Com-parative Example
	27	13	14	15	28
Zinc compound	*Zinc carbonate 5.0 g	Zinc carbonate 5.0 g	Zinc carbonate 5.0 g	Zinc carbonate 5.0 g	Zinc carbonate 5.0 g
Oxycarboxylic acid	Citric acid mono-hydrate salt 15.0 g	Citric acid mono-hydrate salt 15.0 g	Citric acid mono-hydrate salt 15.0 g	Citric acid mono-hydrate salt 15.0 g	Citric acid mono-hydrate salt 15.0 g
pH regulator	–	Monoeth - anolamin e 7.25 g	Monoeth - anolamin e 9.66 g	Monoeth - anolamin e 10.92 g	Monoeth-anolamine 27.89 g
Water	Balance	Balance	Balance	Balance	Balance
Total	500 g	500 g	500 g	500 g	500 g

Liquid pH		3.1	5.5	7.0	8.15	10.0
Ammonia concentration (ppm)	Initial	150	150	150	150	150
	90 min	<1	<1	2	15	110
Hydrogen sulfide concentration (ppm)	Initial	150	150	150	150	150
	90 min	105	14	2	2	3

*: Zinc carbonate is a basic zinc carbonate with the following chemical formula:

$2\,ZnCO_3 \cdot 3\,Zn(OH)_2 \cdot H_2O$

[0052]

[Table 8]

Liquid pH and odor elimination effectivity of zinc oxide, oxycarboxylic acid and pH regulator compositions

		Comparative Example	Example			Comparative Example
		29	16	17	18	30
Zinc compound		*Zinc oxide 5.0 g	Zinc oxide 5.0 g	Zinc oxide 5.0 g	Zinc oxide 5.0 g	Zinc oxide 5.0 g
Oxycarboxylic acid		Citric acid monohydrate salt 15.0 g	Citric acid monohydrate salt 15.0 g	Citric acid monohydrate salt 15.0 g	Citric acid monohydrate salt 15.0 g	Citric acid monohydrate salt 15.0 g
pH regulator		–	Monoethanolamine 5.50 g	Monoethanolamine 8.47 g	Monoethanolamine 9.66 g	Monoethanolamine 23.56 g
Water		Balance	Balance	Balance	Balance	Balance
Total		500 g	500 g	500 g	500 g	500 g
Liquid pH		3.3	5.5	7.0	8.2	10.0
Ammonia concentration (ppm)	Initial	150	150	150	150	150
	90 min	<1	<1	2	10	100
Hydrogen sulfide concentration (ppm)	Initial	150	150	150	150	150
	90 min	100	10	2	2	3

*: The chemical formula for zinc oxide is: ZnO

[0053]

(Examples 19 through 40)

The bases and specified quantity of water (approximately 20° C) were combined in 1000 mL beakers in the proportions indicated in Tables 9 through 12 and stirred with a magnetic stirrer for 60 to 90 minutes. The basic zinc carbonate or zinc oxide zinc compound and carboxylic acid were dissolved in water and the pH of the composition was adjusted with a pH regulator. After the pH was adjusted, the composition was assessed for solution appearance and stability. Prepared samples were also assessed for stability after one month in 5° C and 15° C constant-temperature baths. The results are provided in Tables 9 through 12.

[0054]

[Table 9]

Solubility and appearance and stability of basic zinc carbonate, oxycarboxylic acid and pH regulator compositions

		Example					
		19	20	21	22	23	24
Zinc compound		*Zinc carbonate 0.50 g	Zinc carbonate 0.50 g	Zinc carbonate 0.50 g	Zinc carbonate 0.50 g	Zinc carbonate 0.50 g	Zinc carbonate 0.50 g
Oxycarboxylic acid		Lactic acid 1.68 g	Lactic acid 2.62 g	Lactic acid 3.63 g	dl-malate 1.51 g	dl-malate 2.54 g	dl-malate 3.53 g
pH regulator		Monoeth - anolamin e 5.66 g	Monoeth - anolamin e 13.77 g	Monoeth - anolamin e 21.44 g	Monoeth - anolamin e 14.91 g	Monoeth - anolamin e 30.55 g	Monoeth - anolamin e 45.60 g
Water		Balance	Balance	Balance	Balance	Balance	Balance
Total		500 g	500 g	500 g	500 g	500 g	500 g
** Basic zinc carbonate solubility		Dissolve d ○	Dissolve d ○	Dissolve d ○	Dissolve d ○	Dissolve d ○	Dissolve d ○
Liquid pH		7.1	7.3	7.1	7.4	7.5	7.0
Solution appearance of composition after pH adjustment		Clear liquid com-position	Clear liquid com-position	Clear liquid com-position	Clear liquid com-position	Clear liquid com-position	Clear liquid com-position
**Stability of composition		○	○	○	○	○	○
** Stabilit y with storage	5° C (1 M)	○	○	○	○	○	○
	15° C (1 M)	○	○	○	○	○	○

*: Zinc carbonate is a basic zinc carbonate with the following chemical formula:

$2\,ZnCO_3 \cdot 3\,Zn(OH)_2 \cdot H_2O$

**: Assessment of basic zinc carbonate solubility and stability of composition

○: Clear liquid

×: Cloudy liquid, or contains impurities, sediment and/or precipitate

[0055]

[Table 10]

Solubility and appearance and stability of basic zinc carbonate, oxycarboxylic acid and pH regulator compositions

		Example				
		25	26	27	28	29
Zinc compound		*Zinc carbonate 0.50 g	Zinc carbonate 0.50 g	Zinc carbonate 0.50 g	Zinc carbonate 0.50 g	Zinc carbonate 0.50 g
Oxycarboxylic acid		dl-tartaric acid 2.59 g	dl-tartaric acid 3.50 g	Citric acid mono-hydrate 15.7 g	Citric acid mono-hydrate 25.0 g	Citric acid mono-hydrate 35.0 g
pH regulator		Monoeth-anolamine 27.27 g	Monoeth-anolamine 40.50 g	Monoeth-anolamine 14.95 g	Monoeth-anolamine 27.85 g	Monoeth-anolamine 43.05 g
Water		Balance	Balance	Balance	Balance	Balance
Total		500 g	500 g	500 g	500 g	500 g
** Basic zinc carbonate solubility		Dissolved ○	Dissolved ○	Dissolved ○	Dissolved ○	Dissolved ○
Liquid pH		7.1	6.9	7.1	7.1	7.2
Solution appearance of composition after pH adjustment		Clear liquid com-position	Clear liquid com-position	Clear liquid com-position	Clear liquid com-position	Clear liquid com-position
**Stability of composition		○	○	○	○	○
** Stability with storage	5° C (1 M)	○	○	○	○	○
	15° C (1 M)	○	○	○	○	○

*: Zinc carbonate is a basic zinc carbonate with the following chemical formula:

$2\,ZnCO_3 \cdot 3\,Zn(OH)_2 \cdot H_2O$

**: Assessment of basic zinc carbonate solubility and stability of composition

○: Clear liquid

×: Cloudy liquid, or contains impurities, sediment and/or precipitate

[0056]

[Table 11]

Solubility and appearance and stability of zinc oxide, oxycarboxylic acid and pH regulator compositions

		Example					
		30	31	32	33	34	35
Zinc compound		*Zinc oxide 0.50 g	Zinc oxide 0.50 g	Zinc oxide 0.50 g	Zinc oxide 0.50 g	Zinc oxide 0.50 g	Zinc oxide 0.50 g
Oxycarboxylic acid		Lactic acid 1.57 g	Lactic acid 2.51 g	Lactic acid 3.60 g	dl-malate 1.57 g	dl-malate 2.54 g	dl-malate 3.52 g
pH regulator		Monoeth-anolamine 0.24 g	Monoeth-anolamine 7.8 g	Monoeth-anolamine 16.44 g	Monoeth-anolamine 11.78 g	Monoeth-anolamine 26.95 g	Monoeth-anolamine 41.66 g
Water		Balance	Balance	Balance	Balance	Balance	Balance
Total		500 g	500 g	500 g	500 g	500 g	500 g
** Zinc oxide solubility		Dissolved ○	Dissolved ○	Dissolved ○	Dissolved ○	Dissolved ○	Dissolved ○
Liquid pH		7.3	7.3	7.4	7.3	7.2	7.4
Solution appearance of composition after pH adjustment		Clear liquid com-position	Clear liquid com-position	Clear liquid com-position	Clear liquid com-position	Clear liquid com-position	Clear liquid com-position
**Stability of composition		○	○	○	○	○	○
** Stability with storage	5° C (1 M)	○	○	○	○	○	○
	15° C (1 M)	○	○	○	○	○	○

*: The chemical formula for zinc oxide is: ZnO

**: Assessment of basic zinc carbonate solubility and stability of composition

○: Clear liquid

×: Cloudy liquid, or contains impurities, sediment and/or precipitate

[0057]

[Table 12]

Solubility and appearance and stability of zinc oxide, oxycarboxylic acid and pH regulator compositions

	Example				
	36	37	38	39	40
Zinc compound	*Zinc oxide 0.50 g	Zinc oxide 0.50 g	Zinc oxide 0.50 g	Zinc oxide 0.50 g	Zinc oxide 0.50 g
Oxycarboxylic	dl-	dl-	Citric acid	Citric acid	Citric acid mono-

acid		tartarate 2.62 g	tartarate 3.50 g	mono-hydrate 15.8 g	mono-hydrate 25.3 g	hydrate 37.0 g
pH regulator		Monoeth-anolamine 24.00 g	Monoeth-anolamine 36.29 g	Monoeth-anolamine 11.41 g	Monoeth-anolamine 24.09 g	Monoeth-anolamine 40.34 g
Water		Balance	Balance	Balance	Balance	Balance
Total		500 g	500 g	500 g	500 g	500 g
** Zinc oxide solubility		Dissolved ○	Dissolved ○	Dissolved ○	Dissolved ○	Dissolved ○
Liquid pH		7.0	7.0	7.4	7.1	7.0
Solution appearance of composition after pH adjustment		Clear liquid com-position	Clear liquid com-position	Clear liquid com-position	Clear liquid com-position	Clear liquid com-position
**Stability of composition		○	○	○	○	○
** Stability with storage	5° C (1 M)	○	○	○	○	○
	15° C (1 M)	○	○	○	○	○

*: The chemical formula for zinc oxide is: ZnO

**: Assessment of basic zinc carbonate solubility and stability of composition

○: Clear liquid

×: Cloudy liquid, or contains impurities, sediment and/or precipitate

[0058]

(Examples 19, 22, 25, 27, 30, 33, 36, 38, Comparative Examples 31 through 35)

The antimicrobial activity of the example compositions was assessed. Comparative Examples 31 through 35 were also prepared with copper gluconate, sodium lactate, sodium tartarate, sodium malate and trisodium citrate in the same concentration as the examples (0.1 weight percent) and assessed for antimicrobial activity. The results are provided in Table 13.

[0059]

[Table 13]

Strain	Example								Comparative Example				
	19	22	25	27	30	33	36	38	31	32	33	34	35
									Copper gluconate	Sodium lactate	Sodium tartarate	Sodium malate	Trisodium citrate
S. aureu 209P	–	–	–	–	–	–	–	–	+	+	+	+	+
E. coli IFO3301	–	–	–	–	–	–	–	–	+	+	+	+	+

Criteria

+: Bacterial growth

–: No bacterial growth

[0060]

The above results show that the antimicrobial and deodorizing composition of the invention promotes the solubility of zinc oxide and basic zinc carbonate, enhances the stability of the effective ingredients in the composition, effectively eliminates ammonia and hydrogen sulfide odors, and is stable under storage at a low temperature of 5° C and at 15° C.

[0061]

The antimicrobial and deodorizing composition of the invention was shown not only to eliminate odors, but to have more potent antimicrobial action than a composition containing copper gluconate.

[0062]

[Effect of the Invention]

The foregoing demonstrates that the antimicrobial and deodorizing composition of the invention is an extremely safe composition that simultaneously provides both effective deodorization of odors in the household and antimicrobial action.